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# Machine and Tool **BLUE BOOK**

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## MARKING IN MANUFACTURING

SEE PAGE 90

The Newer Hole Makers

Mar-Free Metal Forming  
With New Rubber Die

A Century of Cutting  
Tool Progress at B&S

Economics of Step Drilling



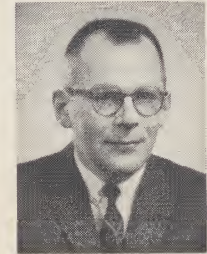
*It's no good 'til you mark it!*

This month's cover story is the first of two articles on Marking in Manufacturing. While the process of affixing some symbol of identification to the machined or stamped part is ordinarily an uncomplicated one, its necessity cannot be denied. Many products flowing out of expensive machine tool lines or representing many hours of skilled labor have questionable value until their size, serial number, or other mark of compatibility is clearly established.

At what pace, for example, could the selective assembly of pistons and cylinders in an engine plant proceed if the diameters of both components were not immediately known? What good is a thread gage if the class of fit is not stipulated? How valuable is the replacement part for the printing press or the camera or the refrigerator or the rifle . . . . . without the model number or the serial number?

Marking devices and marking methods are as varied and as broad as the industrial base itself—from the pocket rubber stamp to the huge metal stencil swung into place by a hoist to code and identify an armored tank. In between are a myriad of hand stamps, press dies, rolls, molds, and in-process and post-process machines and techniques.

In Marking in Manufacturing, author Tom Brinkmann does a capable job of rounding up current practices and bringing them into perspective for the metalworking plant. From his vantage point as executive secretary and general manager of the Marking Device Association, he is well equipped to tell the tale of the mark.



Tom Brinkmann

*Elyas Ashok*

THE FIRST OF A TWO-PART ARTICLE

# MARKING IN MANUFACTURING

By **Thomas H. Brinkmann**  
Executive Secretary  
Marking Device Association

■ Pride of possession and the desire to tell "mine from thine" is one of the basic characteristics of man. Long before he could write or draw, the cave man was identifying himself by an individual mark on the wall of his den. Mason's marks and seal rings

are found among the ruins of early civilizations. Stencils were widely employed in the middle centuries, and continue to find broad application to this day.

In recent history, especially during wartime, industry has come to more

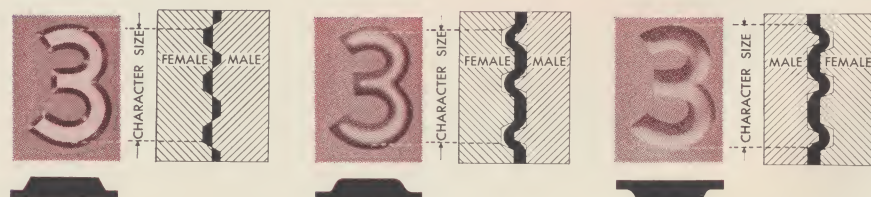


Fig. 1. Semi-coining (left) produces a flat, raised character; embossing (center) a round, raised character; and debossing (right) a round, sunk character.

fully appreciate the necessity for accurate and lasting identification of its products. **Identifying marks of one kind or another now appear on an estimated 30% of all mass produced metal parts.** The long-accumulated skills of the marking device industry are devoted to helping manufacturers solve their in-plant marking problems—to showing how to provide permanent identification free of human error.

How should a given manufactured part be marked—by stamp or by die? Can it be marked as a part of a normal production process, or is a separate operation necessary? Is embossing, coining, or indenting most desirable, and will it be pressed or rolled?

These are typical of the questions which manufacturers must ponder when planning to mark their products. They are the questions which we will consider here as we review the information they need to have about marking and the marking device industry.

## The Most Desirable Marking

**A permanent, highly legible mark is best accomplished by the use of a hardened steel tool to displace the**

**work material.** This manner of identification meets the optimum requirements—permanence and legibility—to such a degree that even characters that have been defaced can be revealed by etching.

The prime consideration in making a mark is that it be accomplished during the production process. In addition to such obvious determining factors as part contour, gage, and method of manufacture, the very nature of the mark itself will play a role in determining how this objective can best be met. The mark might be embossed or coined (kind), in a Roman or Gothic face (character), by pressing or rolling (method), with a logotype or insert die (tool), to name a few possibilities.

## Kinds of Marks

Several kinds of permanent marks can be made. Engraving, for one, can be employed, often on a pantograph machine. Generally, this is not a production technique. Rather, engraving is considered a means of manufacturing other marking devices to be employed in indenting, semi-coining, embossing, and debossing.

Indenting is accomplished by forcing a male character into the piece

GOTHIC	GOTHIC	GOTHIC
ROMAN	ROMAN	ROMAN
RomaN	RomaN	RomaN
Script	Script	Script
ITALIC	ITALIC	ITALIC
Old English	Old English	Old English

Fig. 2. Some of the more popular lettering styles. Each comes in (left to right) sharp faces, flat faces, and open faces.

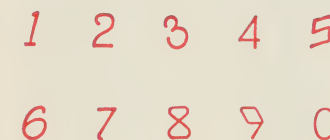


Fig. 3. These high-legibility numbers are individually styled to retain identity even if only partly visible.



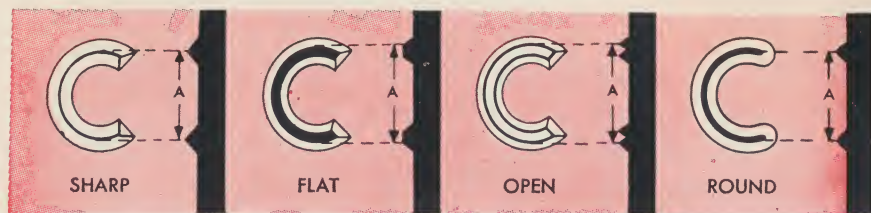


Fig. 4. Nominal size of the character is indicated by distance A.

to be marked. This is the familiar method of permanent marking by material displacement, usually in parts having heavy cross-sectional area. On the other hand, embossing, debossing, and semi-coining are reserved for lighter-gage material like sheet metal. These latter marking techniques are compared in Fig. 1.

(A fourth technique, coining, is similar to semi-coining, except that a flat planishing block is used in place of the male die.)

### Character Styles

A wide range of marking characters is available. Roman or Gothic faces are used most often, although such stylized faces as script and italic are also employed. Fig. 2 shows some of

the character styles. The face contours are designed in different cross sections—sharp, flat, and open.

There is even a special high-legibility face, Fig. 3, for numerals. Each number has a distinctive shape, so that even if only partly visible, it cannot be mistaken for any other number.

Measurement of sizes requires additional understanding since impressions vary in relation to their depth. Measurements are therefore taken from the face of the character, as is indicated in Fig. 4.

Different face widths are available, Fig. 5, ranging from "extra condensed" to "super extended." (In the "standard" face, width is 60% of height.)

Material and heat treatment are other obvious factors of variation.



Fig. 6. Rolling is preferred marking method. (Left) Circular workpiece rolls against flat tool; (right) circular tool rolls against flat workpiece.



Fig. 7. Hand stamps are most elementary marking tools.

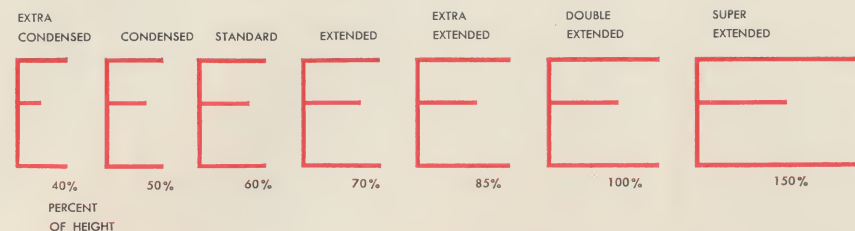


Fig. 5. Letter styles come in a range of widths, expressed as a percentage of height.

Characters are generally made of carbon or alloy steel. Non-ferrous tools are made for marking soft, pliable materials such as leather or wood.

A character can be right or left handed. The "regular" character reads right to left so that its impression is normal. The "reverse" character reads left to right so that its impression is backward (for use in a mold or a forming die).

### Marking Methods and Tools

There are three basic methods of delivering the pressure necessary to produce a permanent mark—impact, pressing, and rolling. Impact is produced by a sharp blow or hammer action, in which the entire force and weight of the downward stroke is instantly absorbed by the workpiece.

Impact marking is limited in its application since the number of characters that can thus be sunk simultaneously into the piece is obviously a function of the amount of force which can be delivered.

In pressing, the workpiece absorbs the force more slowly, giving the surface metal more time to flow to shape. Further, a punch press exerts the same force on each workpiece in the lot, assuring a uniform marking quality.

Marking pressure is also delivered by rolling. In general, this is the preferred method of marking. The prime advantage lies in the fact that the small amount of impression being made at any instant lessens the pressure required. This has the added benefit of providing longer tool life.

continued

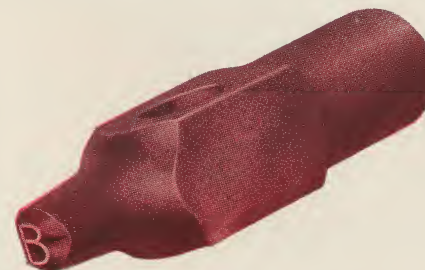


Fig. 8. Inspector's hammer stamp for identifying castings and ingots.



Fig. 9. This logotype is segment of a roll type die.



## Marking Tool and Die Terminology

**BEVEL:** The slant, or angle, from the face of an engraved character to the background is termed the first bevel, or character bevel. The clearance taper, or sighting angle, on the sides of hand stamps is called the second bevel.

**BLANK:** A piece of steel, brass, or other metal machined to accommodate the characters, design, symbol, etc., to be engraved.

**BOTTOMING:** Stamping or impressing a stamp or die to the background of characters: ironing out upset or metal displaced by the stamping die.

**CHARACTER:** The single term for letters and/or figures.

**CHARACTER HEIGHT:** The top-to-bottom measurement of a character.

**CHARACTER WIDTH:** The left-to-right measurement of a character. Refers to the degree to which characters are condensed or extended.

**CONCAVE STAMP:** Characters are cut on a depressed contour surface fitted to mark a convex surface.

**CONVEX STAMP:** Characters are cut on a raised contour surface fitted to mark a concave surface.

**DIE:** Any engraved blank used for marking by means of stamping, rolling, branding, embossing, coining, or semi-coining characters or designs.

**BRANDING DIE:** A metal die that can be heated to a temperature sufficient to burn or scorch characters or designs into nonmetallic substances.

**COINING DIE:** A female, or sunk, engraved die used in pairs or with a flat planisher to produce raised characters on surfaces of thick material.

**DEBOSSING DIES:** The same as embossing dies except to produce sunk characters or designs in sheet material.

**EMBOSSING DIES:** A pair of dies used to produce raised characters in sheet material with a thickness 1/8th of the character size or less.

**FLAT ROLL DIE:** A flat die used in a marking machine to roll impressions on round, tapered, or tubular parts.

**LEAF STAMPING DIE:** A press die engraved with flat face regular characters and heated to transfer colored foil onto nonmetallic surfaces.

**ROLLER DIE:** A circular die with raised or sunk characters or designs engraved on the periphery of the blank. Sometimes called a knurl die or roll die.

**SEMI-COINING DIE:** A pair of male and female dies used to produce raised characters with a thickness exceeding 1/8th the character size.

**STENCIL DIE:** A die used to cut characters or designs through thin sheet metal, paper, or other material.

**FACE OF CHARACTER:** The stamping edge of engraved characters.

**FACE OF STAMP:** Striking end.

**HAND STAMP:** Any hand-held stamp with which the force for the impression is a hammer blow.

**HEAD OF STAMP:** End which is struck.

**HOLDER:** A tool to hold type, logotype, or stamps in alignment for marking.

**INSERT:** A piece of type or a logotype designed to be fitted or inserted into die, fixture, a marking tool; usually interchangeable with other inserts.

**LETTERS AND FIGURES, STEEL:** Single character hand stamps. Sometimes called "single pieces."

**LETTER STYLE:** The engraved design of characters, i.e., Gothic, Roman, Italic, Script, etc.

**LOGODIE OR LOGOTYPE:** A single die or insert with two or more engraved characters.

**LOW-STRESS CHARACTER:** Round-faced character.

**MOLD STAMP:** Single- or multiple-character hand stamp or press die for marking plastic, glass, rubber, and die-sinking molds; and forming and forging dies. Cut with flat face reverse characters to stamp sunk reverse impressions which produce raised characters reading "right" on the molded or forged product.

**MORTISE:** A recess machined into a holder or die to accommodate interchangeable inserts.

**NUMBERING HEAD:** A device made up of one or more rotating wheels each with a series of engraved characters. Characters are changed manually or are automatically indexed for serial imprinting. Used by hand or in marking machines.

**PRESS STYLE STAMP:** A die used in a punch, arbor, hydraulic, pneumatic, or other press.

**REGULAR CHARACTERS:** Characters engraved "reverse" on a marking tool. Produce a regular or "normal" impression.

**REVERSE (FORWARD-READING) CHARACTERS:** Characters engraved "normal" on a marking tool. Produce reverse impression on mold or forging die.

**SHOULDER:** The surface, or land, from the base of characters or engraving to the sides of the blank.

**TIER STYLE:** Characters engraved one above the other in a vertical arrangement instead of horizontally as normally read.

**TYPE:** Single characters engraved on blanks used in a holder, chase, mortised die, etc., for collective marking.

Leaf Type: Flat face brass or steel characters cut extra deep on type-high blanks for stamping under heat and pressure.

Ring Type: Type cut for use in curved line holder.

Segment Type: Single characters engraved on the large end of blanks tapered to fit a mortised roller die. Also called wedge shaped.

**TYPE HIGH:** The height (.918") from the base to the character or stamping surface of type or logotype blanks.



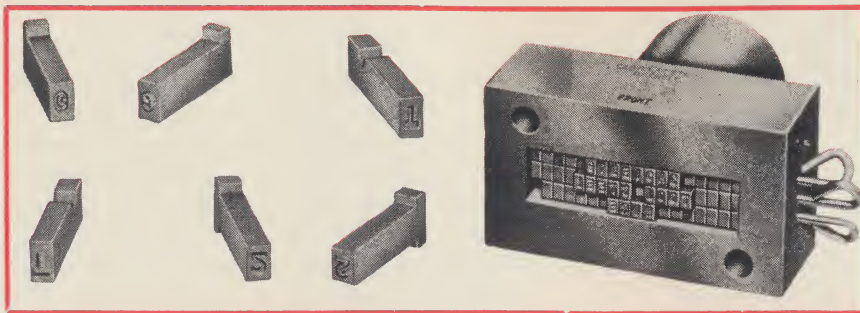


Fig. 10. Typical press holder. Type bodies incorporate some provision for retention in the holder.

Rolling also offers wide adaptability. It can be employed on production machines (such as a screw machine) as well as on specially made marking machines. As can be seen in

Fig. 6, a flat marking tool can be rolled on a circular part, or a circular tool on a flat part. Circular tools can also be rolled on circular parts.

The most elementary tool is the

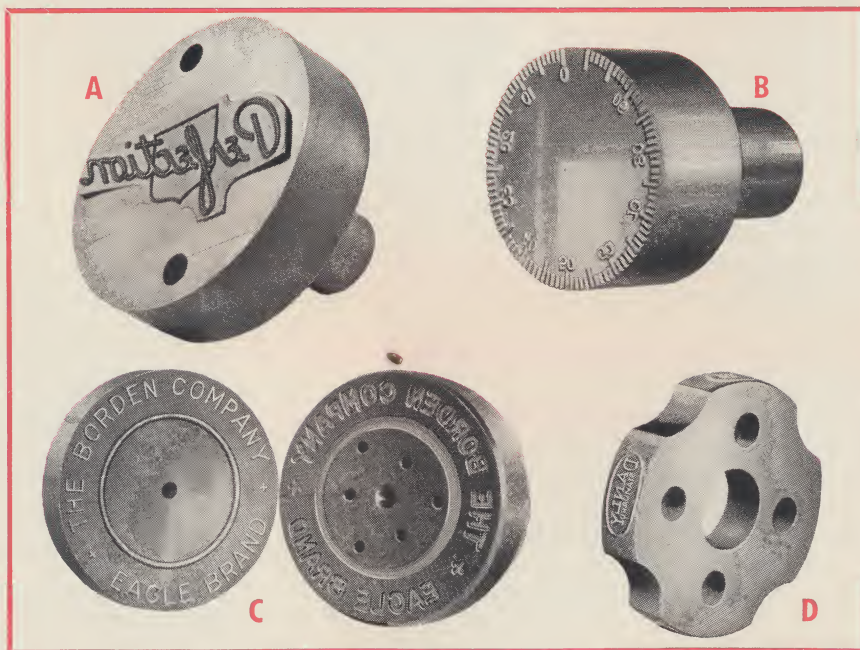


Fig. 11. Marking dies. A: press die for a curved surface; B: press die for dials; C: press die for embossing cans; D: roll die for continuous marking.

### About the author . . .

Thomas H. Brinkmann, a mechanical engineering graduate of Northwestern University's Technological Institute, has been executive secretary and general manager of the Marking Device Association since 1958. Previously, he served a three-year tenure as assistant professor in Northwestern's department of industrial relations. During this time he also served as acting chairman of the department and as secretary to the executive committee of the Technological Institute. His earlier professional career includes service with the department of engineering surveillance at Bendix Aviation's Kansas City division.

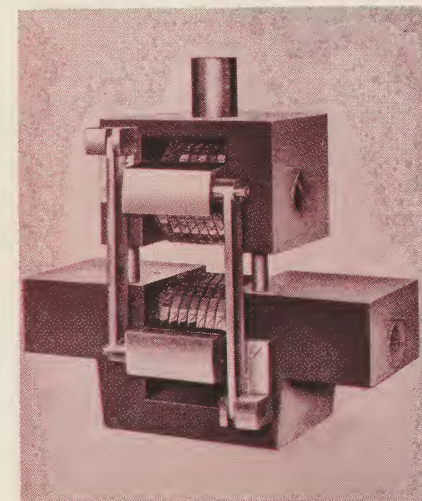


Fig. 12. Automatic embossing numbering head.

individual character hand stamp, Fig. 7. For heavier work, the stamp incorporates a hole, Fig. 8, to receive a wood handle by which it is held while struck with a sledge hammer.

Many marking device manufacturers stock hand stamps, generally sold in sets. In addition, they can supply multiple or special characters. Several characters on one blank (logotypes) are common, as are trade marks and inspectors' symbols. A logotype appears in Fig. 9. The surface plane of the characters can be flat or curved, to correspond to the work surface.

Hand-held stamps are often knurled or patterned for no-slip gripping, while type intended for holders may, for example, be grooved or have shoulders or T-heads. A wide range of holders are manufactured for both type and logos. They can be used by hand or mounted on a press. Fig. 10

shows some of the type bodies and an arrangement of type in a press holder.

Dies are often employed in marking in manufacturing operations. Again, the full range of characters to make the various kinds of marks are available. There are coining, semi-coining, embossing, debossing, roller, and press style dies—to name the common types. An assortment of dies appears in Fig. 11. They can be made in one piece, or with provision for inserting type or logotypes.

Numbering heads are commonly used marking tools. They can be indexed manually (selectively) or automatically in a wide range of styles. Most are held in a press, or designed for use with special marking machines. Special heads can be produced to do almost any kind of numbering work. One style of numbering head appears in Fig. 12.



# MARKING IN MANUFACTURING

By **Thomas H. Brinkmann**  
Executive Secretary  
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■ As stated previously, the primary consideration in marking is to carry out the operation as a part of the production sequence. This is, of course, axiomatic. Yet, the marking industry is constantly called upon to engineer "after" marking. All too often, little or no planning is given to how a part might best be marked.

For parts requiring a forming, blanking, or piercing operation, marking inserts in the die are often the answer. For parts having screw machine or lathe operations, special marking holders can be employed. Fig. 13, for example, is a holder for a lathe toolpost.

A range of separate marking operation methods are available. Hand stamping with hand stamps, type in holders, or logotypes is a basic method. A press die with interchangeable inserts, used in a separate operation, appears in Fig. 14.

For high-production work, special marking equipment is often economically feasible. The range here is from simple hand-operated devices to elaborate hydraulic or pneumatic presses or rolling machines. Fig. 15 shows a crank-type fixture which uses a roll die to mark a conical surface (left) and a flat surface (right).

In Fig. 16, an air cylinder pushes

## part 2

a flat die across a circular workpiece which rotates on contact with the type. A hydraulic marking machine appears in Fig. 17. The insets show it set up with a flat die and cradle for a cylindrical surface (left) and with a roll die for a flat surface (right).

**The configuration of the part is a determining factor in how it is to be marked.** Cylindrical surfaces are generally the best choice, since they permit the widest range of marking techniques, are easily supported, and have little surface variation from one piece to the next. Flat surfaces are good where the operation can be supported and the flatness is uniform, while spherical surfaces are to be avoided. Hand-finished surfaces may not always be uniform enough to accept a clear, sharp impression consistently in high-production marking.

The nature of the part obviously

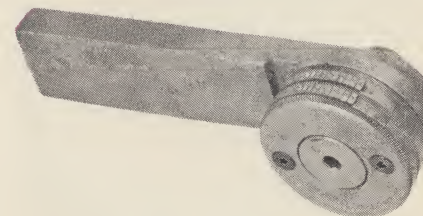


Fig. 13. Type holder for roll marking fits lathe toolpost.

will also determine the metallurgical composition of the marking tool. Special alloy steels are used for severe duty; high-speed steel, for hot work. Most marking devices are made of oil-hardening tool steel hardened to 58 to 60 Rc.

### Selecting the Kind of Mark

Indent marking is used on parts having heavy cross-sectional areas. **Generally, single stamps can be indented successfully in sheet as light as 24 B & S gage. Multiple characters should not be used in sheet lighter than 18 gage.**

Coining, which is like semi-coining, except that a flat planishing block is used to back up the female die, is not advisable for sheet lighter than 16 gage. Maximum recommended depth of characters is .010". Semi-coining requires approximately 50% of the pressure of coining, and is used where the depth of characters is not more than two-thirds the thickness of the metal used.

Embossing can be used on all gages of metal where a raised, curved character face is desired. Characters can be raised to three times the thickness of the material. Debossing is used where enamel filling is desirable. A flat bottom style can be furnished



where the character has a broad stroke. The nomograph, Fig. 18, shows required embossing pressures.

For indent marking, Table 1 is helpful in determining pressures required in pounds per character. It also shows recommended penetration depths for various character sizes. When hand stamping, Table 2 (when used in conjunction with Table 1) will show how many characters can be impressed in one operation.

### Roll Marking

The use of roller dies to indent mark flat work is desirable where the piece is hollow in form and cannot be adequately supported on the underside. In such a case, less distortion of the part is likely to result than were pressing employed. However, on flat pieces which can be supported adequately behind the impression area, rolling will likely cause greater distortion than pressing. In rolling, the piece tends to become concave on the marking side as back pressure is exerted over a wide area while the roller die has virtually line contact. Rolling should be employed where nominally "flat" work resulting from less-than-precise manufacturing is, in fact, uneven.

**Rolling a flat tool on a cylindrical surface is generally the preferred production technique.** However, roll marking of small diameter cylinders with a flat tool can be troublesome, because the tip of the character makes early contact with the work, and is thus subject to breaking, Fig. 19. The solution is to use a shallow character which is prevented by its background from penetrating deeply. The problem, incidentally, is amplified when cylindrical dies are rolled on cylindri-

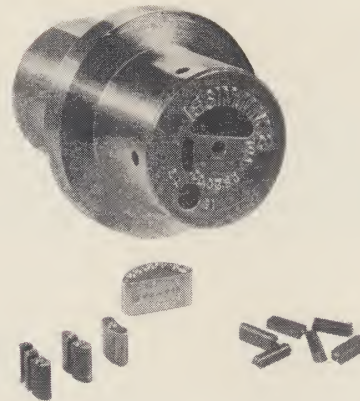


Fig. 14. Dies with interchangeable inserts.

cal work, a method used where the die and the work must be positively geared together, as in marking graduations.

The principle of limiting depth of penetration of a marking tool by limiting the distance that the tip of a character stands out from its background is applied in other marking techniques. It assures a consistent penetration depth and is of particular help when marking both sides of a flat piece at one time.

### Other Techniques for Marking Cylindrical Surfaces

There are two basic choices when it is necessary to indent mark on a cylindrical surface where roll marking equipment is not available. Flat-faced marking tools can be employed, or specially contoured stamps or dies can be obtained. If a flat-faced tool is used, the resulting impression will be deeper in its center than at the top and bottom.

On machined or polished surfaces the depth at the top and bottom of the impression can be as low as .003" and still be legible. A proper character

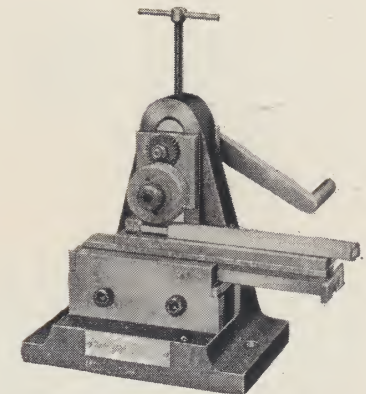
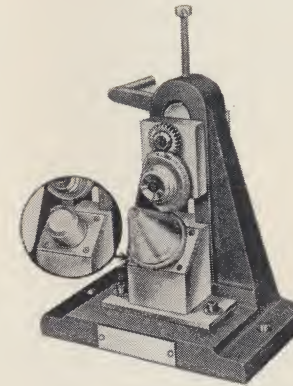


Fig. 15. Crank type fixture for roll marking conical surface (left) and flat surface (right).

size must therefore be selected so that the center of the impression will not be so deep as to require excessive marking pressure.

### Copy Layout

Copy layout is an important marking consideration. The obvious requirement is that the copy must fit into the marking area. In addition, poor layout can have an adverse effect upon tool life and cost and the ability to create a mark having equal depth of impression of all characters. Fig. 20 illustrates this point.

Determination of the necessary character size so that copy will fit into a given space is often misunderstood. The "standard" character can be considered to have a sharp face in the normal width.

The width of such characters is equal to approximately 60% of the height. However, the distance from the center of one character to the center of the next (including the space between them) is roughly equal to the height of the character (and sizes are specified by height). These

relationships are altered for characters such as "M," "W," and "I," and the figure, "1."

Since marking characters are available in several widths, there are many exceptions to the 1-to-1 space-to-height ratio. For example, a 1/8" character can have an actual width of from 1/32 to 5/32".

**In laying out marking copy, it is the space between characters that is most often overlooked. A marking**

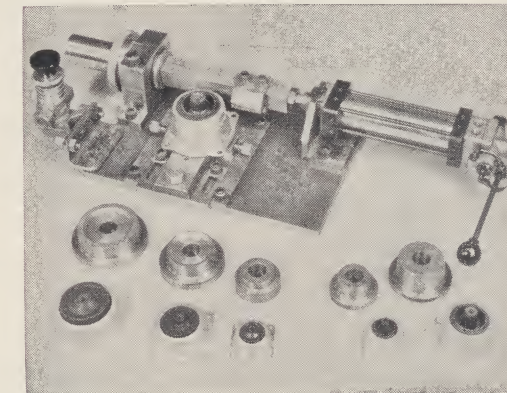


Fig. 16. Air cylinder pushes flat die across cylindrical section of workpiece.



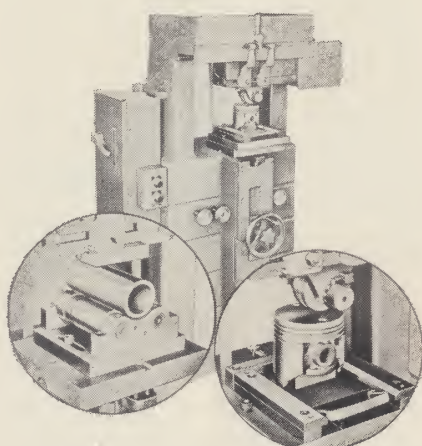


Fig. 17. Hydraulic marking machine. Inset (left) shows roll marking with flat die of work supported in cradle; other inset (right) shows marking of piston head with roll die.

character goes into the surface of the part—not on it. The point of the vee which penetrates deepest into the piece is the point from which the size of the character is measured. The size of the character face at the surface of the piece will always be greater than it is at the point of maximum penetration.

Generally speaking, the smallest character commensurate with good legibility should be specified, even when a more than ample marking surface is available. This practice reduces the pressure necessary to make a clear, well-defined mark.

#### Contacting the Marking Expert

It is obvious that a great number of factors are involved in the selection of the proper tool and technique to solve a given marking problem. Most often the best course is to contact an experienced marking device

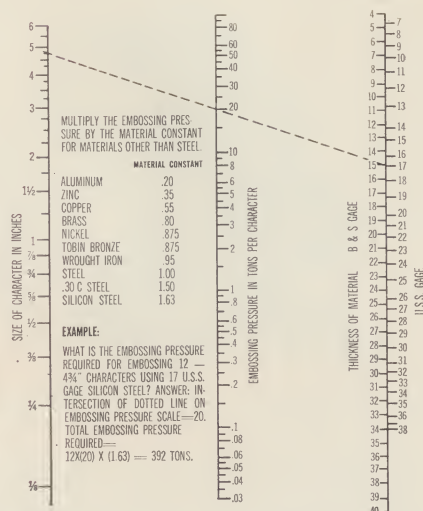


Fig. 18. Nomograph for embossing pressures for male and female dies.

manufacturer. Members of the marking industry are experienced in providing the engineering and tools necessary to solve such problems.

The following information should be furnished:

1. Size and detail of required impression.
2. Rate of production.
3. Location of mark.
4. Material specifications of product.
5. Condition and temperature of surface on which mark must be made.

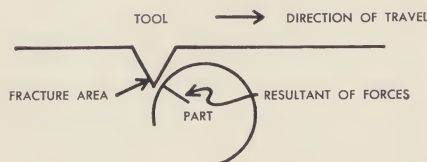


Fig. 19. If the part diameter is too small in relation to the character size, the tip of the character is subject to fracture.

#### Marking Planning Summarized

Here are the major marking techniques which we have discussed. They should be reviewed, in approximately this order, when planning the marking operation in most production situations.

If you have:

**A screw machine or lathe operation**—You may be able to add a special marking holder.

**A forming, blanking, or piercing operation**—You may be able to add a marking insert to the die, or mark with a separate press operation.

That failing, but you have:

**A cylindrical surface**—You may be able to roll a flat marking tool, roll a cylindrical tool, or impact or press

either a contoured or flat-faced tool.

**A flat surface**—You may be able to roll a cylindrical tool, or impact or press a flat-faced tool.

Above all:

**Plan** your marking operation so that it is carried out as a part of your normal production sequence.

#### Telling Your Marking Story

Another consideration in planning to make a mark is the information it must contain. The mark may have to tell:

1. Who manufactured the piece.
2. When it was manufactured—day, month, year, shift.
3. Who inspected the piece.
4. Type of material.

#### 1. A BAD LAYOUT

This example is considered a bad layout. Due to the uneven lines, the word "layout" would receive the brunt of the stroke on its outer edges and be impressed deeper.

#### 2. A GOOD LAYOUT

Here is a well-balanced layout. It will stand up much longer... make more uniform and neater impressions.

#### 3. — DASHES — CAN BE USED

To achieve layout balance, dashes can be used to equalize impressions.

#### 4. A BALANCED THREE LINE LAYOUT

Here is a well-balanced layout. Because the upper and bottom lines are the same length, impressions are equalized—the ends will stand up longer.

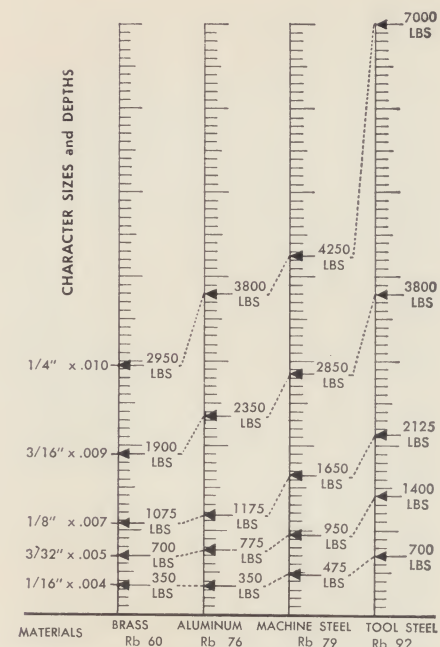


Fig. 20. Some examples of multiple-line layouts.

Table 1. Approximate static pressure required per character for indent marking.



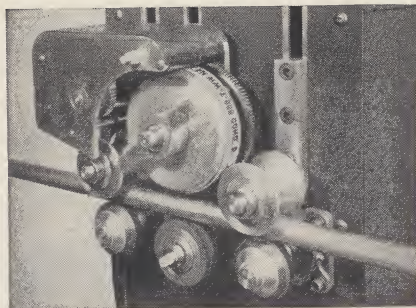


Fig. 21. In this tube and bar marker, the die is a rubber tire mounted on a steel roll.

5. Replacement part number.
6. Operating instructions for the product.

### Attached Plates

So far we have concentrated our attention on permanent marking for identification, as accomplished by material displacement on the part being marked. There is, in addition, widespread use of attached plates—generally employed in marking for instruction. Many such plates, of course, bear identifying material, such as serial numbers.

Most attached plates are purchased from marking device manufacturers, although basic models can be stamped in-plant with machines designed for the purpose. Then, too, many have a space for in-plant marking which is accomplished by using the techniques we have discussed for permanent marking.

A wide variety of plates are available, the most common perhaps being engraved, etched, stamped, embossed, lithographed, or anodized. The chart shown in Table 3 compares various types of attached plates.

In ordering plates (and planning for their use) the two most often

overlooked considerations are manufacturing time and method of attachment (adhesive, screw, rivet, stud, clip, snap, lug, etc.). In addition, specify quantity, size, type, color, use, material, gage, and, if possible, provide a layout of copy.

### Marking with Minimum Material Displacement

There are instances where it is desirable to mark with little or no displacement of material. Available for such requirements are acid etching inks and plastic dies, air-grit stencils, and electric etching equipment. Rubber dies can also be utilized with an infinite variety of inks. Fig. 21 is a close-up view of a tube and bar marker. The die is a rubber tire mounted on a steel roll.

### Marking for Shipment

No article about marking would be complete without mention of that employed in shipping. Countless millions of dollars worth of materials are lost in shipment annually for want of proper marking—to say nothing of costly delays. The biggest single problem lies in the use of illegible or undersize characters.

In most instances, stencils, properly applied, are the best answer. They can be cut in-plant with a stencil cutting machine, and the ink quickly applied by spraying or by brush,

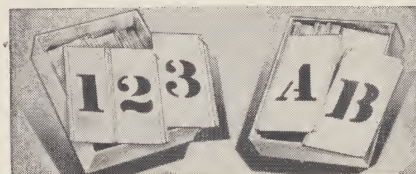


Fig. 22. For ease in handling and proper spacing, these stencils are of interlocking design.

HAMMER WEIGHT, LBS.	FORCE PER BLOW, LBS.
3/4 Lbs.	4,000 Lbs.
1 Lbs.	6,000 Lbs.
1-1/4 Lbs.	7,000 Lbs.
1-1/2 Lbs.	8,000 Lbs.
1-3/4 Lbs.	10,000 Lbs.
2 Lbs.	12,000 Lbs.
2-1/4 Lbs.	14,000 Lbs.
2-1/2 Lbs.	17,000 Lbs.
3 Lbs.	30,000 Lbs.
3-1/2 Lbs.	37,000 Lbs.
4 Lbs.	45,000 Lbs.
5 Lbs.	55,000 Lbs.
6 Lbs.	65,000 Lbs.

Table II. Estimated maximum exerted force per hammer blow.

fountain brush, or roller. Durable metal stencils (generally brass) are available for often-used trademarks or addresses. They can also be furnished in plastic, which has the advantage of easy roll-up storage coupled with flat-laying characteristics when in use. Adjustable individual inter-locking characters, Fig. 22, can be used for in-plant fashioning of stencils.

### The Marking Industry

The marking industry is a polyglot service business which provides marking tools and engineering of all sorts and description. Here we have dealt with but a portion of an industry which also makes such things as rubber stamps and dies, seals, stencils, inks, nameplates, and badges. It is an industry created by early engravers and stencil cutters who gave way to the manufacturers of metal marking

Type of Plate	Relative Cost	Durability	Resistance to Abrasion	Decorative Appearance
Engraved	Low, in small quantities	Good	Good	Good
Lithographed	Low	Fair	Fair	Fair to Good
Etched	Low	Good	Good	Good to Excellent
Anodized	Moderate	Good	Excellent	Good
Stamped	Low, in small quantities	Good	Good	Good
Plain or litho embossed	Low	Good	Fair	Good
Silk Screen	Low	Fair	Fair	Good
Decorative embossed	High	Good	Good	Excellent
Cast	High	Excellent	Excellent	Good

Table III. A comparison of different types of attached plates.

tools and dies and the full range of marking devices.

Engraving, along with typesetting and sinking, are the basic skills of the industry today. He who makes the steel marking die has much in common with, and often himself is, the seal sinker and stencil cutter. He who makes marking type can employ it in the manufacture of rubber dies for mounting on machine or handle (the rubber stamp).

Reference to leading firms in the marking industry can be obtained from the Marking Device Association, 1611 Chicago Ave., Evanston, Ill. An affiliate of this organization, the Steel Marking Tool Institute (same address) is comprised of leading marking houses which are specialists in the manufacture of steel marking tools and dies and production marking machines.